

WHAT IS CLAIMED IS:

1. A displacement detection apparatus comprising:

a light beam illuminating system for converting a linearly polarized light beam emitted from a light emitting element into a substantially parallel light beam and irradiating a relatively moving object with the light beam through a light beam splitting optical system, said light beam splitting optical system splitting the single parallel light beam emerging from said light beam illuminating system into a plurality of polarized light beams whose polarized states are different from each other;

a focusing optical system for focusing the plurality of split light beams to different positions on a surface of the relatively moving object;

a polarizing prism for splitting reflected light beams from the relatively moving object on the basis of a difference between the plurality of directions of polarization;

a plurality of light receiving optical systems for individually detecting the different polarized light beams split by said polarizing prism and outputting light receiving signals of the respective light beams; and

comparator for comparing light receiving signal levels of the respective light beams to detect a relative displacement of the relatively moving object.

2. An apparatus according to claim 1, wherein
said light beam splitting optical system has an optical
performance capable of splitting the light beam
emerging from said light emitting element and, at
5 positions where the light beams are focused by said
focusing optical system, spatially separating the
focusing positions of the focused light beams.

3. An apparatus according to claim 2, wherein the
10 surface of the relatively moving object is
substantially vertically irradiated with the plurality
of focused light beams.

4. An apparatus according to claim 1, wherein a
15 slit-shaped marking or a three-dimensional marking is
formed on the surface of the relatively moving object
to generate a reflectance difference.

5. An apparatus according to claim 4, wherein
20 said light beam splitting optical system has an optical
characteristic with which the focusing positions of the
plurality of focused light beams are spatially
separated at an interval almost equal to a width of the
marking.

25 6. An apparatus according to claim 1, wherein
said light beam splitting optical system has a parallel

plate shape.

7. A displacement detection apparatus comprising:

5 a light beam illuminating system for converting a
linearly polarized light beam emitted from a light
emitting element into a substantially parallel light
beam and irradiating a relatively moving object with
the light beam through a light beam splitting optical
system, said light beam splitting optical system
10 splitting the single parallel light beam emerging from
said light beam illuminating system into a plurality of
polarized light beams whose polarized states are
different from each other;

15 a focusing optical system for focusing the
plurality of split light beams to different positions
near an end portion of the relatively moving object;

20 a polarizing prism for splitting reflected light
beams from the relatively moving object on the basis of
a difference between the plurality of directions of
polarization;

25 a plurality of light receiving optical systems for
individually detecting the different polarized light
beams split by said polarizing prism and outputting
light receiving signals of the respective light beams;
and

a light receiving signal comparator for comparing
light receiving signal levels of the respective light

beams to detect a relative displacement of the relatively moving object.

8. An apparatus according to claim 1 or 7,
5 wherein said light beam splitting optical system is a crystal optical element.

9. An apparatus according to claim 1 or 7,
10 wherein a boundary portion is formed on the surface of the relatively moving object to generate a reflectance difference.

10. A magnetic recording apparatus using said displacement detection apparatus of claim 4,
15 comprising:

a head arm having the marking or reflectance boundary portion formed on an upper surface;

a rotary positioner having said displacement detection apparatus on a rotary arm; and

20 a head arm drive motor control unit for controlling a current of a head arm drive motor of a hard disk drive to synchronize a motion of said rotary positioner with a motion of said head arm so that an output from said displacement detection apparatus
25 becomes constant as a position of said rotary positioner varies.

11. A rotary encoder using said displacement detection apparatus of claim 4, comprising:

the slit-shaped marking or reflectance boundary portion formed on a rotary disk surface; and

5 said displacement detection apparatus on a fixed object side to receive the plurality of reflected light beams from the marking or reflectance boundary portion on a moving scale and detect a scale origin from a difference signal between the plurality of light
10 receiving signals.

12. A linear encoder using said displacement detection apparatus of claim 4, comprising:

the slit-shaped marking or reflectance boundary
15 portion formed on linear encoder scale surface; and

said displacement detection apparatus on a moving object side to receive the plurality of reflected light beams from the marking or reflectance boundary portion on the linear encoder scale and detect a scale origin
20 from a difference signal between the plurality of light receiving signals.

13. A magnetic recording apparatus using said displacement detection apparatus of claim 9,

25 comprising:

a head arm having the marking or reflectance boundary portion formed on an upper surface;

a rotary positioner having said displacement detection apparatus on a rotary arm; and

a head arm drive motor control unit for controlling a current of a head arm drive motor of a hard disk drive to synchronize a motion of said rotary positioner with a motion of said head arm so that an output from said displacement detection apparatus becomes constant as a position of said rotary positioner varies.

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14. A rotary encoder using said displacement detection apparatus of claim 9, comprising:

the slit-shaped marking or reflectance boundary portion formed on a rotary disk surface; and

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said displacement detection apparatus on a fixed object side to receive the plurality of reflected light beams from the marking or reflectance boundary portion on a moving scale and detect a scale origin from a difference signal between the plurality of light receiving signals.

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15. A linear encoder using said displacement detection apparatus of claim 9, comprising:

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the slit-shaped marking or reflectance boundary portion formed on linear encoder scale surface; and

said displacement detection apparatus on a moving object side to receive the plurality of reflected light

beams from the marking or reflectance boundary portion on the linear encoder scale and detect a scale origin from a difference signal between the plurality of light receiving signals.

1. A linear encoder scale with a plurality of light receiving signals.